pines and deciduous trees are traversed by extensive never-failing rivers, are provided with constant springs and lakes; the climate is less variable than that of Australia, droughts less frequent, and floods not so severe, in fact the climate is moderated and ameliorated.

The *Eucalypti*, or gum trees, shed their leaves principally during summer, which do not then readily decay, being of a dry, harsh nature, and charged with resinous matter; but deciduous trees shed their leaves in autumn at a time when bush-fires are not prevalent, during the rainy reason, and therefore, readily decay and produce vegetable soil. The vegetable soil on the ranges here is greatly produced by the decay of tree-ferns. It is questionable whether the leaves of the gum trees respire moisture to the same extent as deciduous trees, the gum leaves being so dry and filled with resin or oil.

As tree planting, timber producing, and forest conserving is a study worthy of the engineer, much attention is given to it in Europe, and the engineers of woods and forests are there appointed, because drainage is necessary and irrigation in some instances advantageous. Drainage is absolutely necessary to ensure the growth of the tree when young, and it should be borne in mind that if a tree becomes stunted when young it scarcely ever recovers, but either dies or remains a stunted unshapely tree quite unfit for timber.

I believe Dr. Mueller has recommended the establishing of forest boards in all the districts, similar in constitution to the road and shire boards, and to these the forests of the district should be entrusted, for the purpose of preventing unnecessary destruction of timber, for enriching the forests, and for their future preservation by the proper planting and introduction of fresh and new trees.

Art. XIX.—*On the late Exceptional Season and Frequency of Auroras.* By R. L. J. Ellery, Esq.

[Read 12th December, 1870.]

The late season, from April last to the present date, has been of so exceptional a character, occurring moreover at one of the sun-spot periods, when our luminary has been labouring under one of his exanthematous paroxysms, when auroras and great disturbances of the

magnetic conditions of the earth have been unusually frequent, that it not unnaturally suggests itself that there may possibly be some connection between the sun's condition and these climatic changes.

We know that during these spot periods the sun's surface is often teeming with spots frequently of large dimensions. Spots and penumbræ, sometimes cover from a 60th even to as much as a 30th of the sun's visible hemisphere ; and it can easily be imagined that the modification, if not obliteration, of so much sun force, must largely affect the conditions of the earth and its atmosphere, although in what manner or to what extent remains to be ascertained. The influence of these changes is evident enough so far as the earth's magnetism is concerned, and instances are on record where a rapid change on the sun's surface has been accompanied by almost simultaneous quivers of the earth's magnetism. It is, moreover, now pretty well established that our maximum of magnetic disturbances agrees with the maximum of sun spots recurring about every ten years, and the probable relation between large disturbances of the earth's magnetism and the state of the weather has already been several times suggested.

Some years ago, Dr. Balfour Stewart suggested that "Aurora displays might be secondary electric currents due to small but rapid changes, caused by some unknown influence in the magnetism of the earth;" he compared the earth and its atmosphere to a Ruhmkorffs machine, the moist upper strata of the earth as well as the upper strata of the atmosphere composing the secondary conductors in which currents will take place whenever the magnetism of the earth changes from any cause."

He further states, "These views would appear to be confirmed by the very interesting records of earth currents obtained by Mr. Airy at the Greenwich Observatory, in which it is found that during times of very great magnetic disturbance, there are strong earth currents alternating from positive to negative, the curves lying nearly equally on both sides of the Zero." In the Phil. Mag. of Feb. 1870, Dr. Balfour Stewart, referring again to this subject, says, "A further development of this idea has lately occurred to me, in consequence of a remark of my friend Mr. Lockyer, that the Zodiacal light may possibly be a terrestrial phenomenon, and may therefore be somehow connected with the phenomena of terrestrial magnetism. For not only will secondary

currents be caused in a stationary conductor in presence of a magnetic core of variable power, but also in a conductor moving across the lines of force of a constant magnet. The question arises, have we on the earth such moving conductors? In answer to this, let us reflect what takes place at the equator. When once the anti-trades have reached the upper regions of the atmosphere, they will become conductors from their tenuity; and as they pass rapidly over the lines of the earth's magnetic force, we may expect them to be the vehicles of an electric current, and possibly to be lit up as attenuated gases are when they conduct electricity. May not these form the Zodiacal light?

"Such moving currents will, of course, re-act on the magnetism of the earth. We may therefore suppose that somewhat sudden and violent changes are likely to take place in the earth's magnetism at those seasons at which the earth's great wind-currents change most rapidly. May not this account for the excess of disturbances at the equinoxes?

"Besides the anti-trades, there are also, no doubt, "convection-currents," caused by the daily progress of the sun, taking place in the upper regions of the earth's atmosphere. May not these also be the vehicle of currents as they cross the lines of the earth's force, and account, to some extent at least, for the daily variations of terrestrial magnetism? and may not this be the reason of the likeness observed by Mr. Baxendall, between the curves denoting the daily progress of the wind, and those denoting the variation of the declination magnet? Such currents (in as far as they are electric conductors), taking place in the upper regions of the atmosphere, would not be felt by the earth-current wires at Greenwich, and I think Mr. Airy has noticed that this is the case. But the tidal wave represents a motion of a conductor on the earth's surface, with two periods in one lunar day. This motion cannot produce a very great secondary current; but may it not be sufficient to account for the lunar-diurnal magnetic variation, which is also very small?

"Such a current taking place in a conductor electrically connected with the earth's upper surface ought to be felt by the Greenwich wires; and, if I am not mistaken, Mr. Airy has detected a current of this nature.

"May we not also imagine that there are two varieties of aurora—one corresponding to stationary conductors under

a very rapidly changing core, and the other to rapidly moving conductors under a constant core? And might not an aurora of the latter kind indicate the approach of a change of weather?

"These remarks are thrown out in order to invite comment and criticism, and they will have served their purpose if they direct attention to the part that may be played by moving conductors in the phenomena of terrestrial magnetism. It will be noticed that these remarks do not touch upon the mysterious and interesting connexion believed to exist between magnetic disturbances and the frequency of solar spots."

The last six years may be considered as constituting a period of unusually dry seasons.

The first radical change in this order of things occurred in the beginning of April, this year, shortly after the occurrence of one of the most brilliant auroras ever witnessed here, and which was general in both hemispheres, appearing with great splendour in the north; from this time cloudy skies, and unusually frequent and copious rains became the ordinary state of climate, until a few weeks ago. I have since then frequently noticed that several of the brightest auroral displays were quickly followed by what we usually call bad weather—storms of wind, with thunder and rain. This has appeared so marked, that I sometimes found myself unwisely venturing a prediction of bad weather, simply because of the occurrence of an aurora.

These coincidences brought to my mind Dr. Balfour Stewart's suggestions, and I have lately examined our meteorological and magnetic records for the several months under review in order to ascertain to what extent auroras have been followed by marked changes in weather, and although the results are not quite conclusive, they appear sufficiently confirmatory to warrant me drawing attention to them, and to encourage careful observation in this direction.

The following information has been gathered solely from the records of our own observatory, but I intend comparing these with observations made over the rest of the Australian continent, Tasmania, and New Zealand, so soon as the whole year's records are available, and bringing the results under your notice in a supplementary paper at some early meeting.

In looking over the magnetograph papers for the last twelve months, a series of disturbances of greater or less

extent is manifest nearly throughout that period, comparatively few days only being quite free; the vibratory movement of the declination, and in a smaller degree of the horizontal force also, which mostly takes place during the summer months, and which occurs generally towards midnight and also towards sunrise, being particularly conspicuous by its frequency and extent from November, 1869, till the beginning of April, 1870; from June and during the winter months the extent of the disturbances decreased, and were even comparatively small, until August when they again became more frequent.

The greater disturbances, which are of the nature generally accompanying auroral light, occurred on the following dates (of which sample papers are given); the dates upon which auroras were actually observed are also given.

Year.	Month.	Magnetic Disturbance.	Auroras.
1870	Jan.	3	
		4	
		8	Also reported by Mr. Todd, of Adelaide, as a fine display.
	Feb.	1	Visible from 8 to 10 p.m.; shortly after 9 p.m. some magnificent streamers.
		10	
		11	
	Mar.	20	
		21	
	April	5	Visible all through the evening; at times very brilliant, and particularly at 10.30 p.m.
		6	
		22	
		23	
		28	
	May	16	
		20	Faint only; at 10.30 showed more distinct.
	June	13	
		14	
		16	
		17	
	July	5	
		28	
	Aug.	3	
		7	

Year.	Month.	Magnetic Disturbance.	Auroras.
1870	Aug.	19	
		20	
		21	Shortly before 7 p.m. some fine streamers visible.
		22	
		23	
	Sept.	4	
		5	
		6	
		7	
		19	
		20	Visible in early evening until after 8 p.m., but
		21	not brilliant.
			Visible from 9 p.m.; most brilliant at 11 p.m.
		24	On the evenings of the 24th, 25th, and 26th, a very fine display of the Aurora Borealis was observed by Prof. Neumayer in Germany (Palatinate).
			Traces only visible.
		25	
		26	
		27	Traces only visible in S.E.
		30	
	Oct.	1	
		15	Streamers 30 deg. to 40 deg. high at 10.30 p.m.
		21	
		24	
		25	Shortly after midnight a beautiful display,
		26	though cloudy.
			Visible night and evening; fine red streamers,
	Nov.	9	though bright moonlight.
		10	Auroral light visible, but no streamers.
		15	Visible for a short time at 9.30 p.m.
		17	,, ,, during the evening.
		18	,, ,, ,, at 9.20 p.m. fine streamers.
		19	
		20	At 11 p.m. traces visible; at 10 minutes past midnight on 21st a fine display, with streamers extending from S. to S.W.
			NOTE.—Mr. Gilbert, the journalist, reports to have seen a splendid Aurora shortly after 4 a.m. on the 21st, the whole extent of the southern sky from the horizon upward being illuminated by a reddish light, and terminating in something like a corona, but no streamers at all were visible. The whole appearance vanished instantaneously when a severe clap of thunder occurred at about 20 minutes to 5 a.m.
		21	
		22	Visible between 11 and midnight.

Year.	Month.	Magnetic Disturbance.	Auroras.
1870	Nov.	23	Traces visible during the evening.
		24	„ „ „
		25	
		28	Slight Aurora from 8.30 to 10 p.m.
		29	
	Dec.	5	
		6	
		9	Faint streamers.
		10	
		11	

The following table shows the dates upon which auroras were distinctly observed during 1869 and 1870, and the kind of weather that followed in each case.

1869. Jan. 10.—Traces of an Aurora; no change in weather.
20.—Aurora reported from Guichen Bay.
21.—Aurora seen at Melbourne; the 5 days succeeding very hot and boisterous, with thunderstorms.
Feb. 3.—Aurora seen at Melbourne; no marked change.
April 15.—Very fine display; nearly a week after weather became boisterous and showery, but only for a few days.
Sept. 4.—Aurora seen; 2 days afterwards heavy squalls and rain showers for about 3 days.

1870. Jan. 8.—Aurora seen; hot and oppressive weather a few days afterwards.
Feb. 1.—Aurora seen; hot and boisterous for 2 days after.
April 5.—Fine Aurora; hot and sultry for a few days after, with rain, thunder, and lightning—followed a week after by heavy and steady rain, with frequent showers.
May 20.—Faint Aurora; no change in weather until the end of May, when it became dull and showery, which lasted nearly through the whole of June.
Aug. 22.—No marked change.
Sept. 21.—Very boisterous and squally weather setting in the day after, with heavy rain, and lasting several days.
24. } Auroras; boisterous and showery weather, continu-
25. } ing until the 29th.
Oct. 21.—Warm and sultry weather for a few days afterwards.
26.—Steady rain the day after, and hot and boisterous; with thunder and lightning and rain showers the 2 following days.

Nov. 9.—Hot and sultry for 26 days afterwards, with thunder and lightning on the 11th, and heavy rain and squally and showery 2 following days.

15. 17. 18. 20. 21. During this time weather generally fine, but dull and sultry, with thunderstorm on the early morning of the 21st, followed in the afternoon by heavy squalls and rain showers and cold, boisterous weather, lasting until the morning of the 23rd.

Nov. 23. 24. 25. Boisterous and squally weather, with rain showers on the 25th, 26th, and 27th.

29.—Boisterous and squally, with rain showers on the 30th.

It may be remarked with reference to the first table, that the number of magnetic disturbances recorded of a nature generally accompanying auroras, is greater than that of observed auroral phenomena; it is very probable, however, that on many of these occasions auroras occurred, but by reason of cloud, haze, or moonlight were not observed here. During 1869 and early part of 1870, the Zodiacal light was very frequently seen, and sometimes of considerable brightness. Since the great auroral period has set in (April 5), it has only been observed faintly on one or two occasions.

The mean temperature, humidity, and rainfall, for each month of this auroral period, as compared with the means of the same months for the last twelve years, is as follows:

Month.	Temperature.		Humidity.		Rainfall.			
	Average last 12 Years.	1870.	Average last 12 Years.	1870.	Average last 12 Years.		1870.	
					Amount.	No. of Days.	Amount.	No. of Days.
Jan. .	66.5	67.3	.64	.60	1.684	8	3.150	4
Feb. .	65.4	66.5	.66	.62	1.874	8.2	0.025	1
March .	64.1	64.6	.66	.67	1.525	7.6	0.338	3
April .	58.9	60.8	.72	.78	1.997	10.3	4.878	15
May .	53.3	51.3	.78	.81	2.134	13	2.784	10
June .	49.4	50.3	.81	.83	1.806	13.7	3.316	21
July .	47.8	46.6	.81	.82	1.896	14.8	3.161	14
August .	50.1	48.9	.76	.78	1.620	14.2	2.136	15
Sept. .	53.4	51.5	.72	.78	2.265	15.7	5.875	17
October	57.1	58.0	.70	.76	3.092	14.3	4.384	12
Nov. .	61.1	59.3	.65	.73	1.870	10	3.229	13
Dec. .	63.5	—	.64	—	2.843	9.7	—	—

I lay these simple facts before you without venturing upon any deductions. We know too little about the matter

yet. On a former occasion I stated to you my belief that the key to our more general meteorological changes and conditions of the earth's surface would eventually be found in the variations of the condition of the sun, and if one may be allowed to draw a broad inference from the facts I have brought under your notice, it would in some degree go to support this belief. Such rapid strides have of late years been made in our knowledge of solar physics, and in the means of observing every state and change of our luminary, that if the relations suggested really do exist, we may reasonably hope that at no very remote period they may be traced out from their intricate involvement.

Art. XX.—*On a New Form of Spectroscope.*

By R. L. J. Ellery, Esq.

[Read 12th March, 1871.]

This was an oral description of a new form of a *seven prism Spectroscope* which was exhibited to the meeting. The instrument in its general construction did not materially differ from other large spectroscopes. The new feature was the method adopted for adjustment of the prisms to minimum deviation, which could be accomplished by simply pointing the observing telescope to any desired part of the spectrum; and it was so arranged that any number of prisms, from one to seven, could be used and adjusted by the mechanism.

The accompanying diagram will fully explain the arrangement, $p^1\,p^2\,p^3\,p^4\,p^5\,p^6\,p^7$ are the prisms attached to the link work jointed at $a\,b\,c\,d\,e\,f\,g$. The first prism is pivoted to the table at the point F, and to the last prism is attached a right-angled piece $R\,A$, pivoted at the joint h. By moving the arm A of the right-angled piece, the whole series of prisms is moved, the link work expanding or contracting by the slotted radial arms, moving over the centre pin C, which again travels in the slot $S\,S$ in the table. It will readily be seen, therefore, that all the parts being properly gauged and made, the whole series of prisms will be moved symmetrically by moving the arm A, which is rigidly fixed to the observing telescope, and it follows that by pointing the telescope to any desired part of the spectrum, the prisms will all move proportionally, and